XXIV Giornate Cardiologiche Torinesi
"ADVANCES IN CARDIAC ARRHYTHMIAS AND GREAT INNOVATIONS IN CARDIOLOGY"
Turin, October 25-27, 2012
Centro Congressi Unione Industriale

L'ottimizzazione della stimolazione biventricolare è sempre necessaria?

Torino, 26 ottobre 2012

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Ospedale "M.G. Vannini"
Istituto Figlie di San Camillo - Roma

Sì, è sempre necessaria !!!

- Perché ?

  …. A suboptimal programming of the AV and/or VV interval may partially contribute to the presence of AV or LV dyssynchrony and, consequently, may curtail the beneficial effects of CRT (Bertini M, Europace 2009)

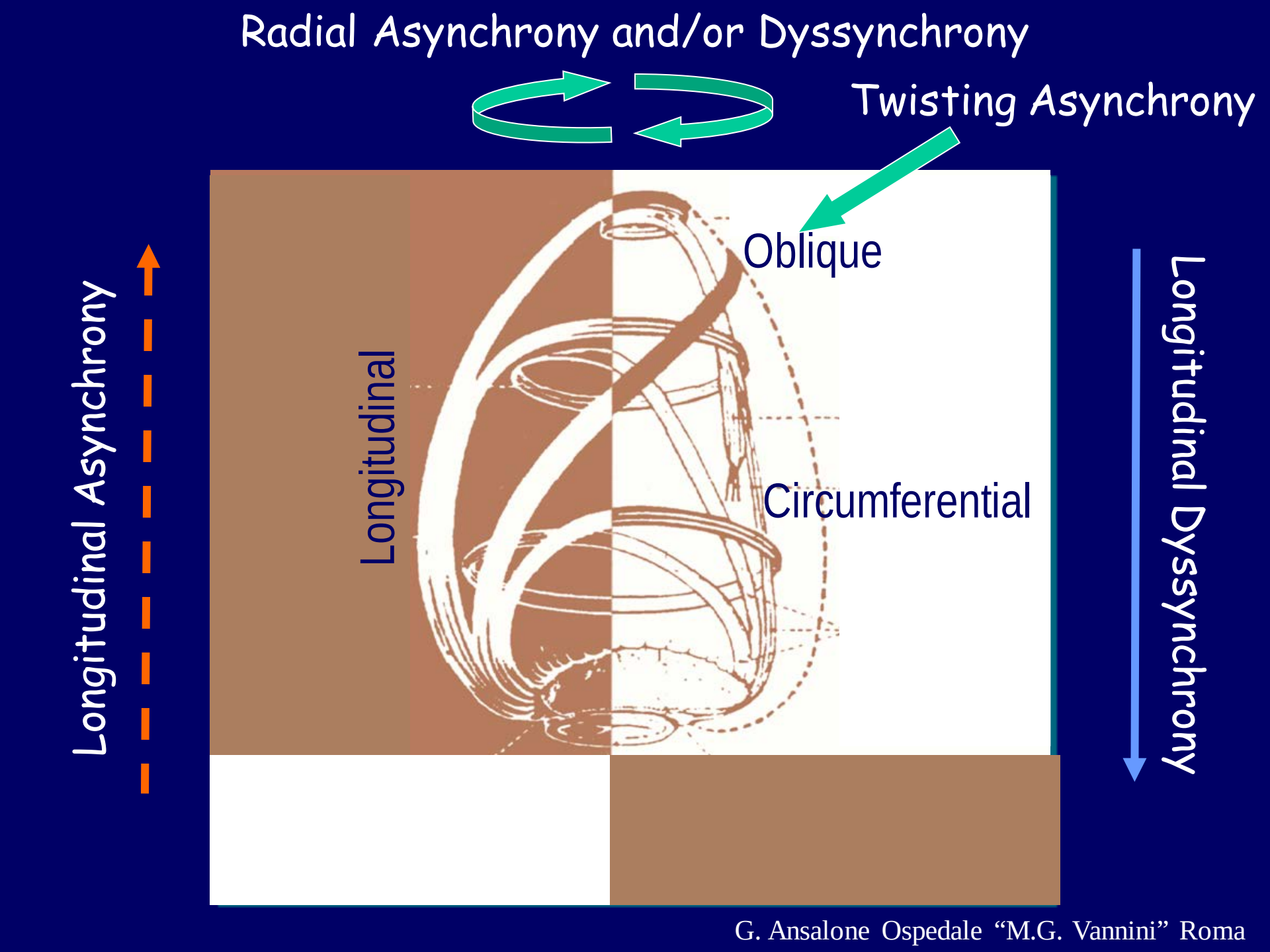
- Come ?

….

….

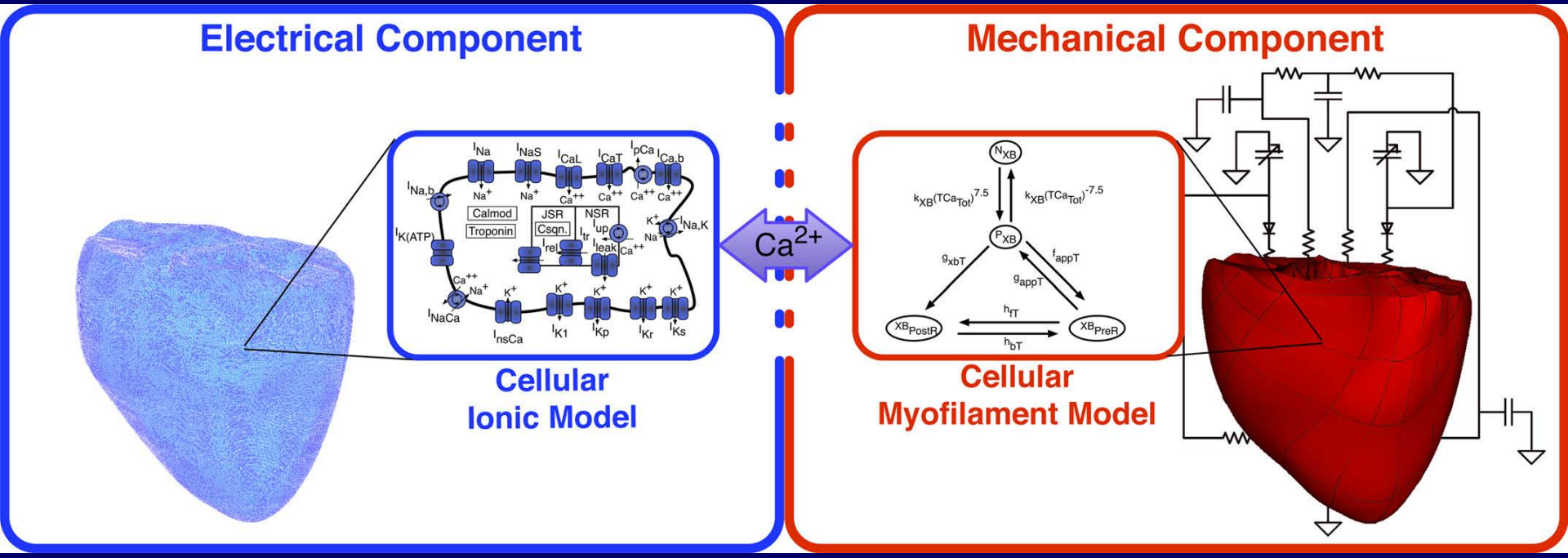
- Quando ?

….

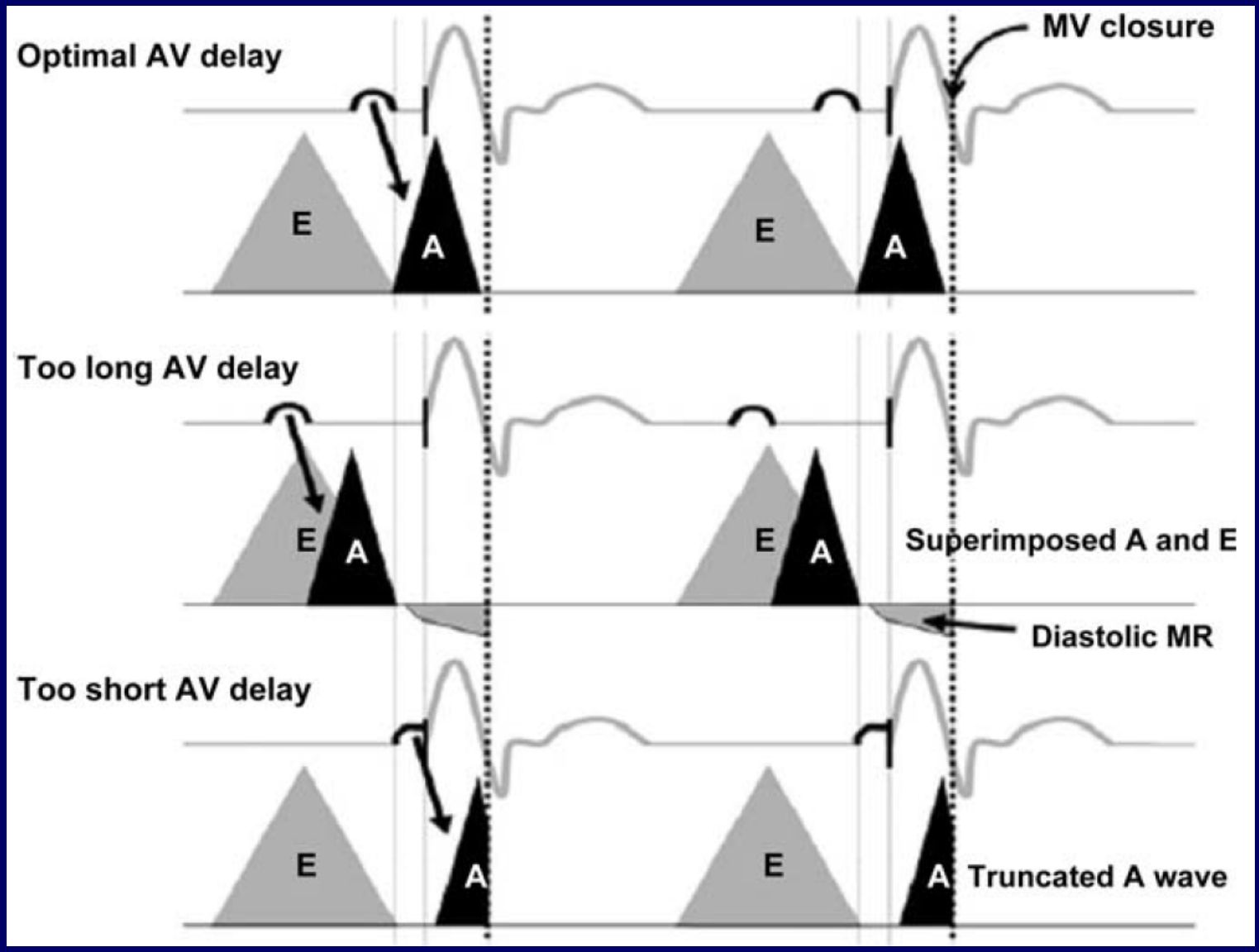


G. Ansalone Ospedale "M.G. Vannini" Roma

Electromechanical modeling of the ventricles

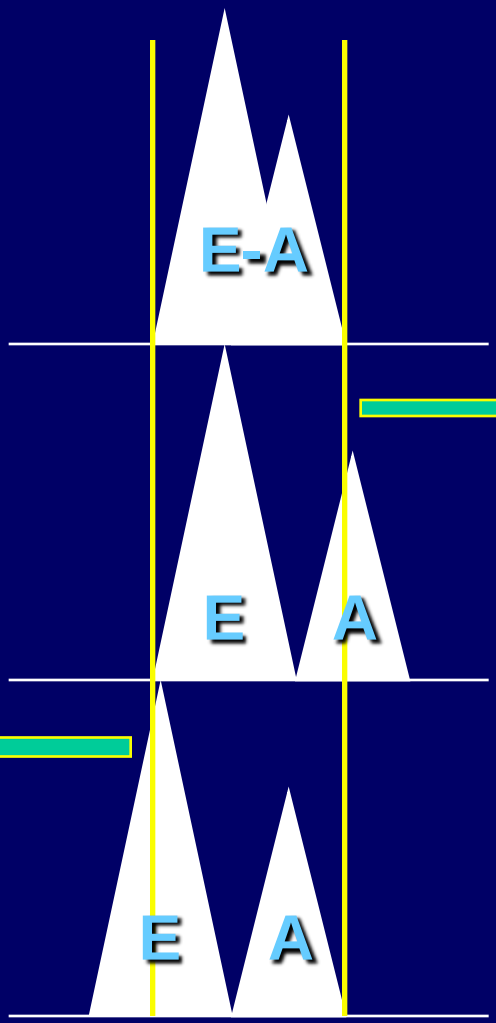


Trayanova NA, Am J Physiol 301: H279-H286, 2011


Optimal AV delay
MV closure
E
A
E
A
Too long AV delay
E
A
E
A
Superimposed A and E
Diastolic MR
Too short AV delay
E
A
E
A
Truncated A wave

Improving LV filling time with pacing

LBBB	AV block I°	Interatrial delay

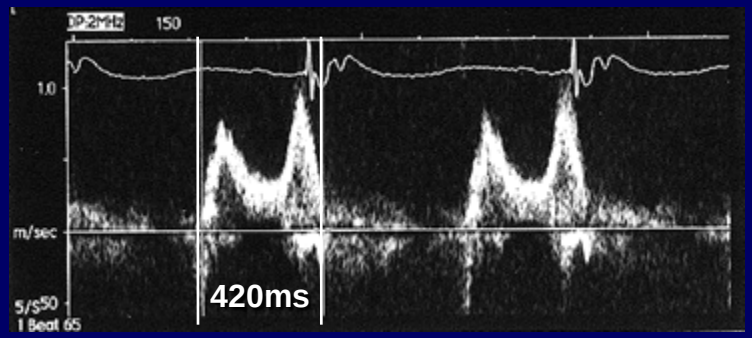


A-V Sequential pacing with short AV delay

Biventricular pacing

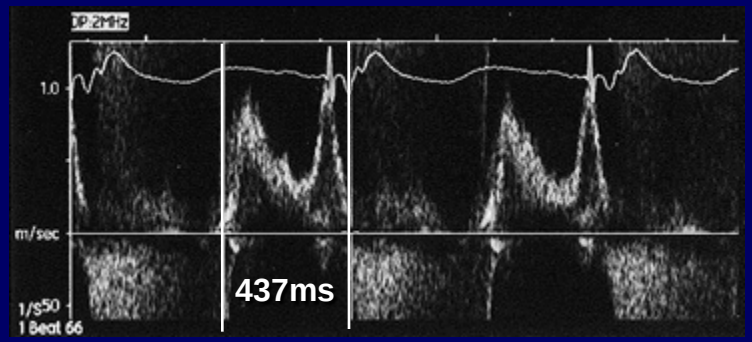
Intervallo AV e tempi diastolici

AV 150 ms



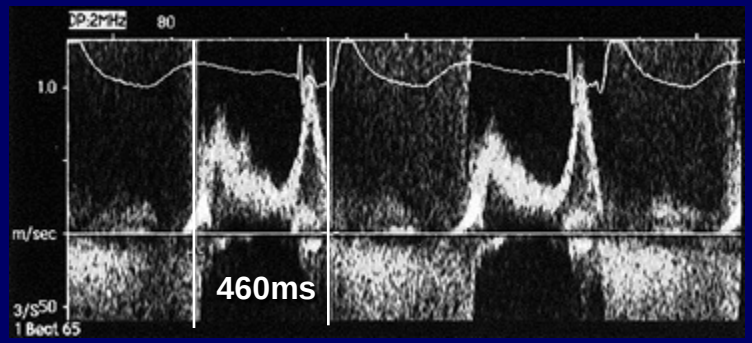
Spike - A = 43 ms

AV 120 ms



Spike - A = 63 ms

AV 80 ms



Spike - A = 103 ms

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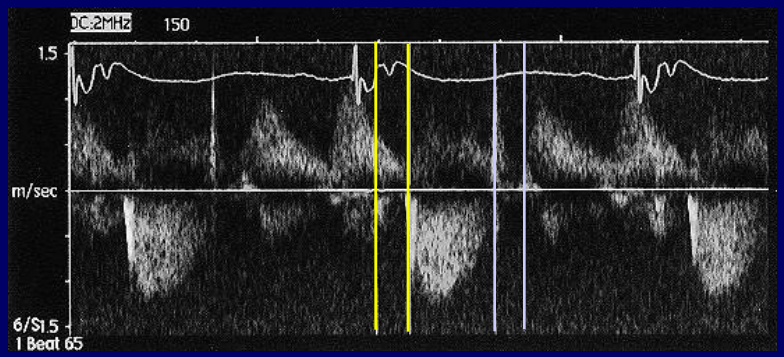
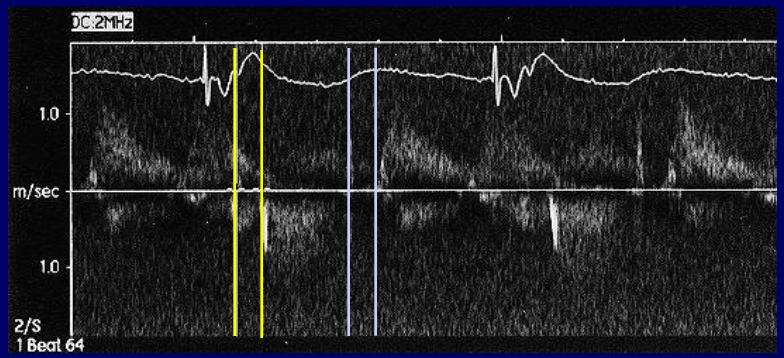
Intervallo AV e tempi diastolici

AV 150 ms



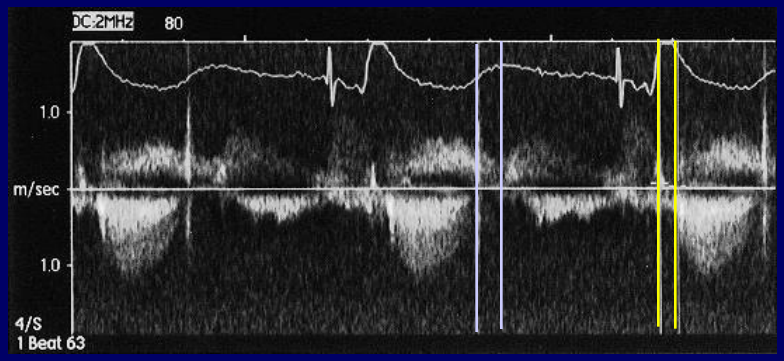
ICT 110 ms
IRT 100 ms

AV 120 ms



ICT 83 ms
IRT 80 ms

AV 80 ms



ICT 60 ms
IRT 75 ms

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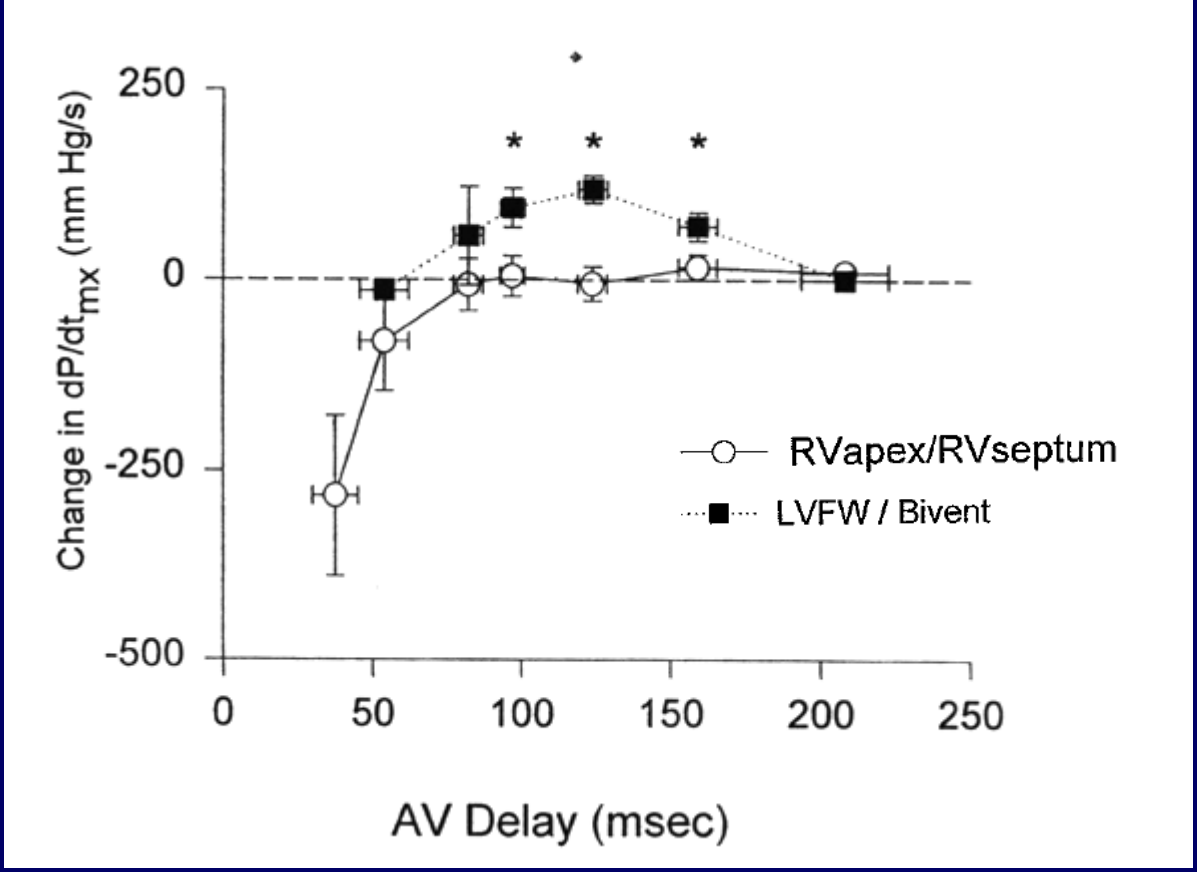
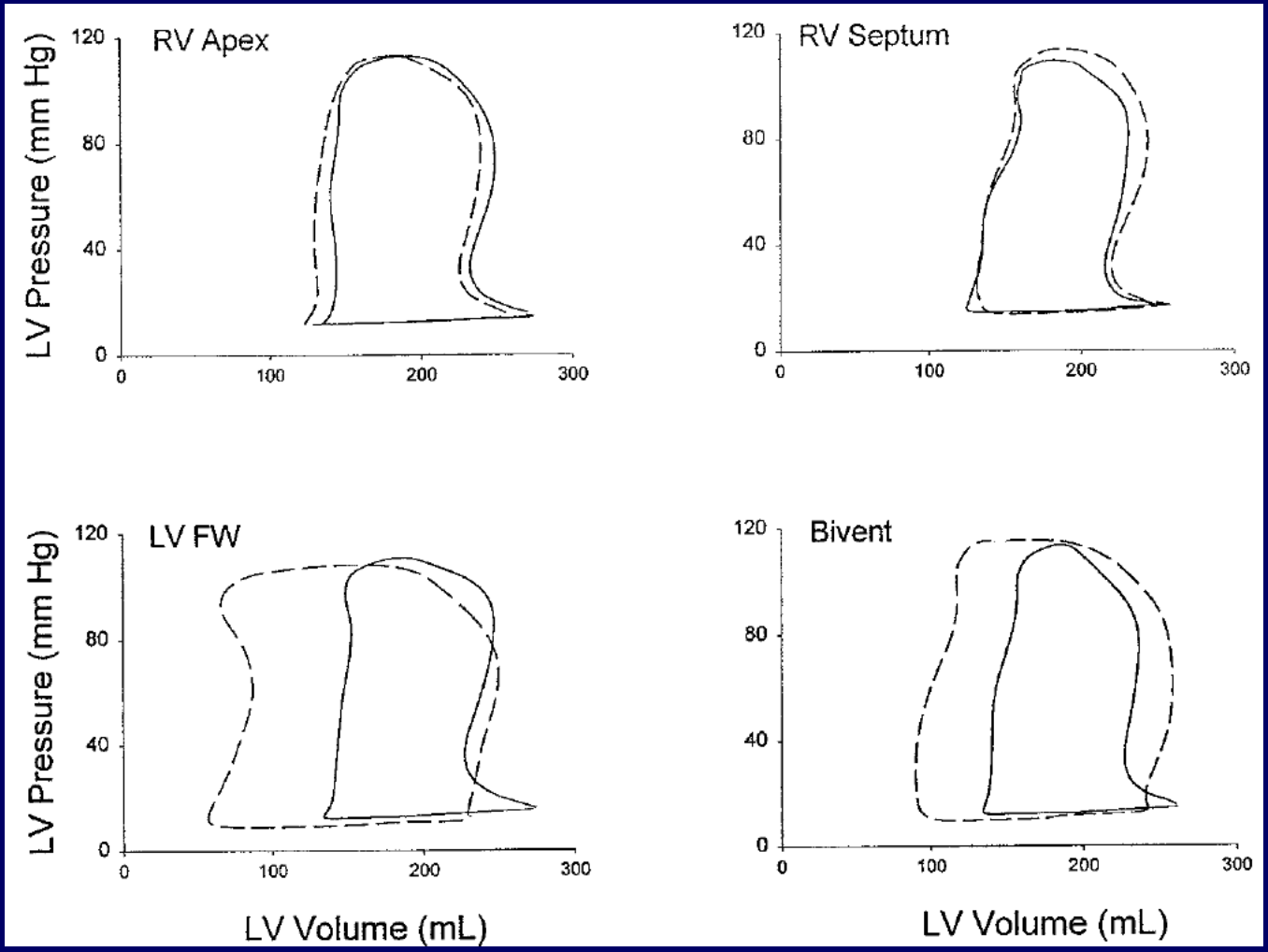
Intervallo AV e differenti siti di pacing

- AV delay has less influence on LV function than pacing site (range 125± 49 ms)



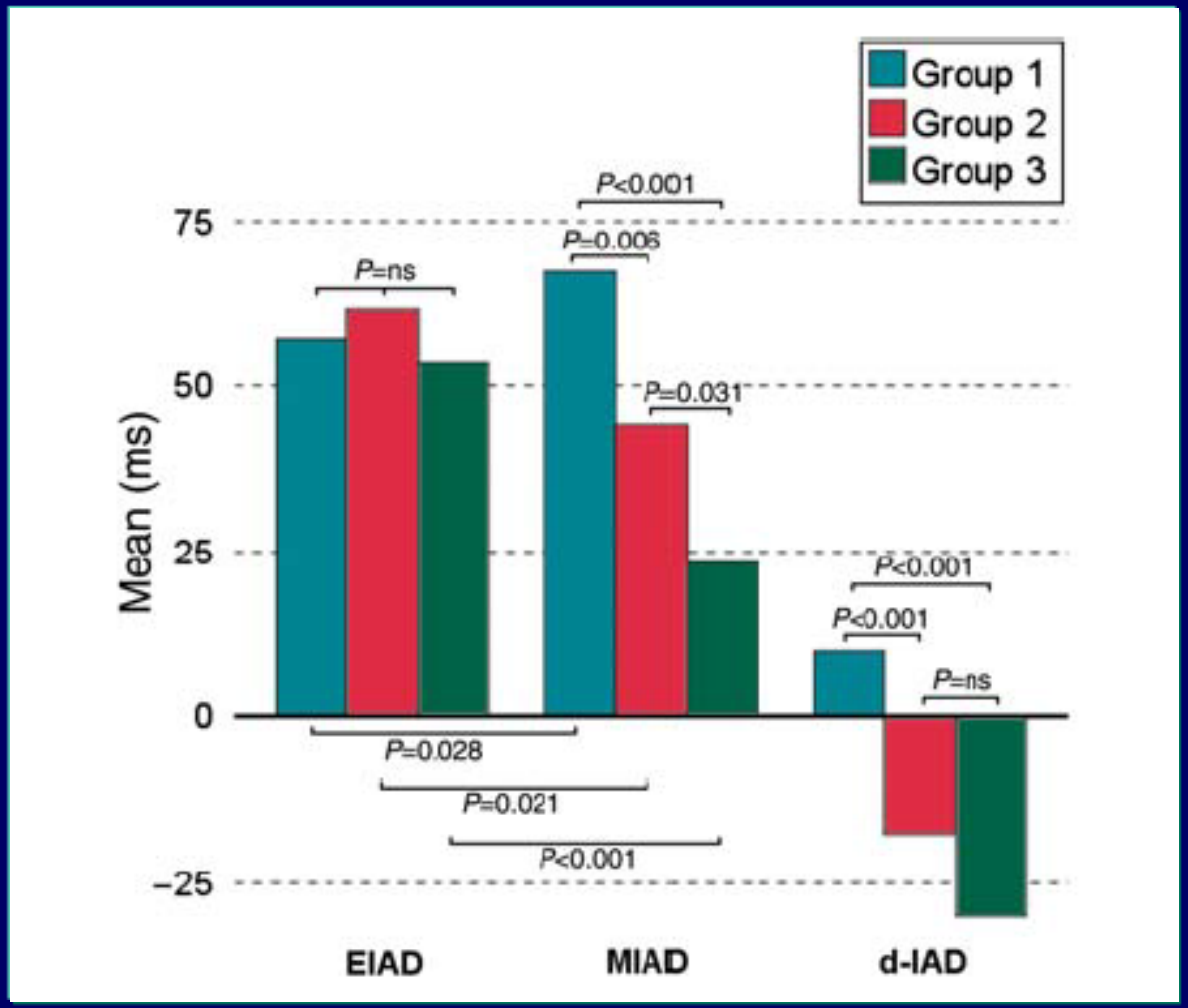
Kass DA, Circulation 1999

PV loops from a patient with baseline LBBB as a function of varying pacing site



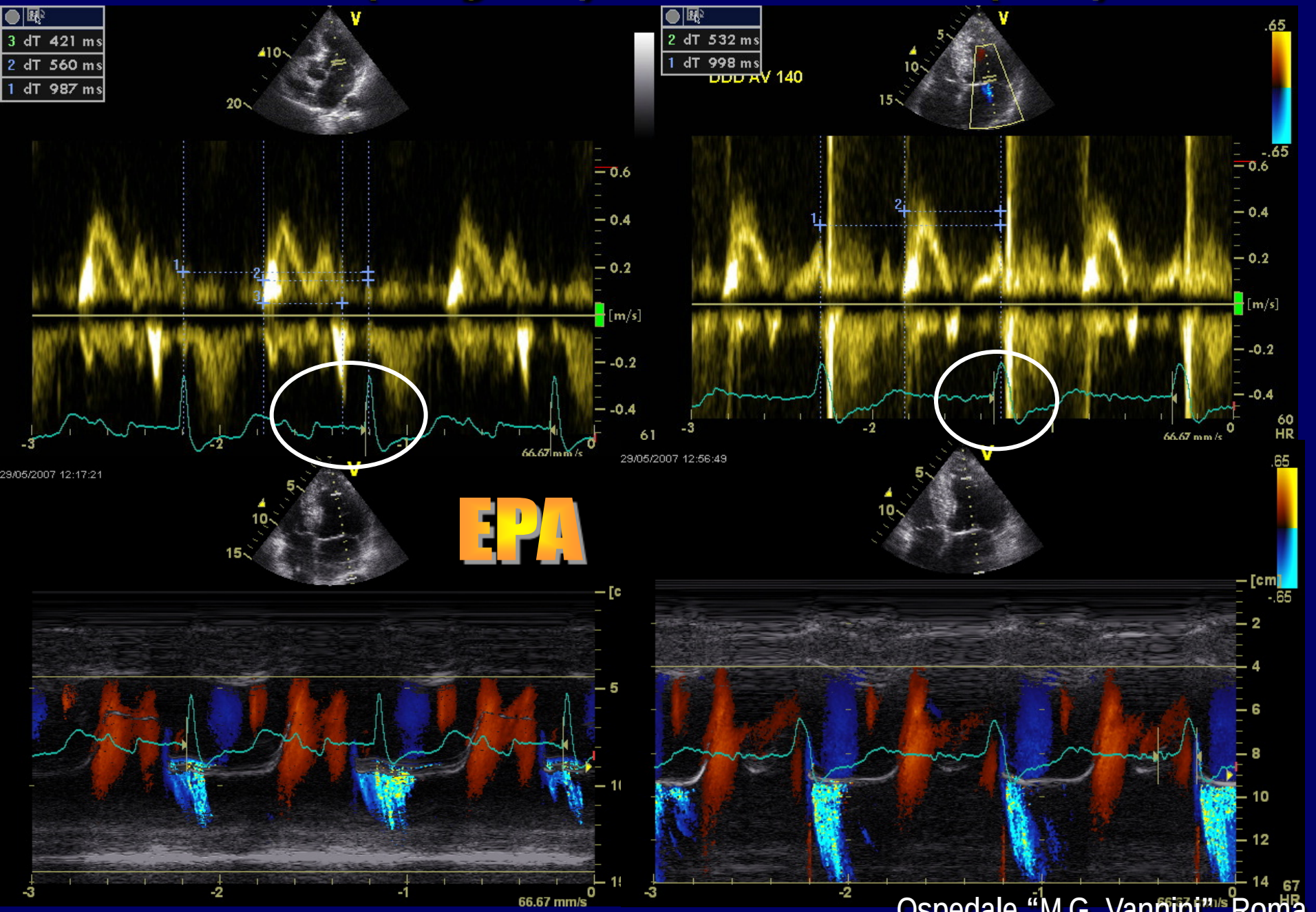
Kass DA, Circulation 1999

Mechanical interatrial delay and optimal AV delay



Porciani Europace 2012

AAIR (long AV) versus DDDR (BIV)



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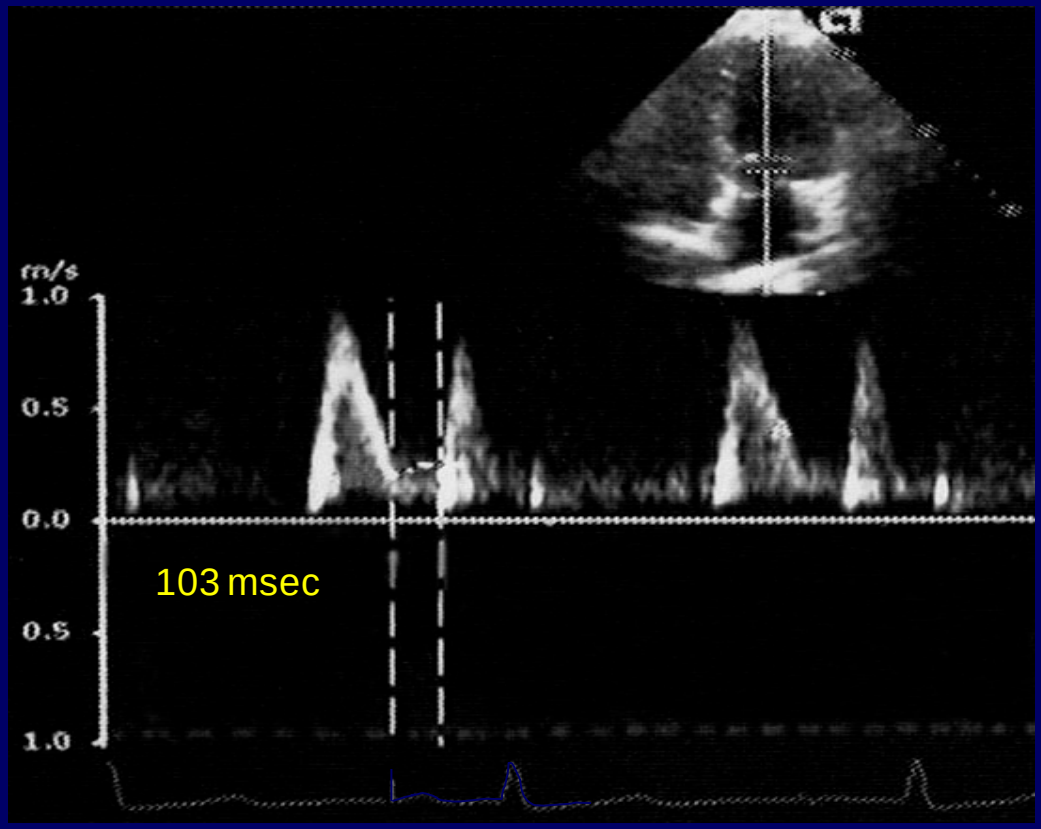
METODO

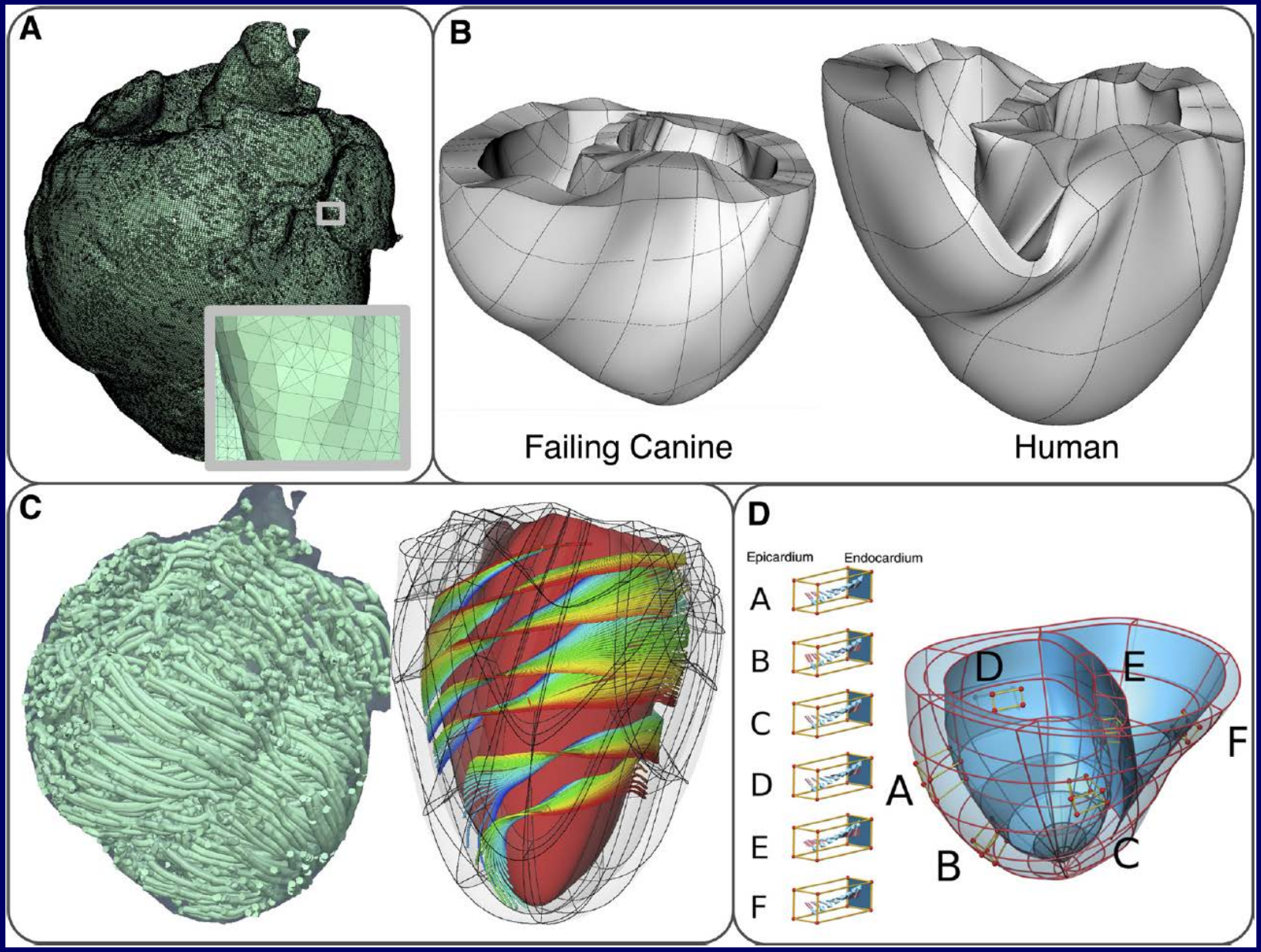
TCI calcolato come media di 3 intervalli tra lo spike del pacing temporaneo sulla traccia ecg dell'ecocardiografo ed il piede dell'onda A del flusso transmitralico in proiezione 4 c apicale



Intervallo spike pacing temporaneo - piede onda A

L. Antonini et al. ANMCO 2007

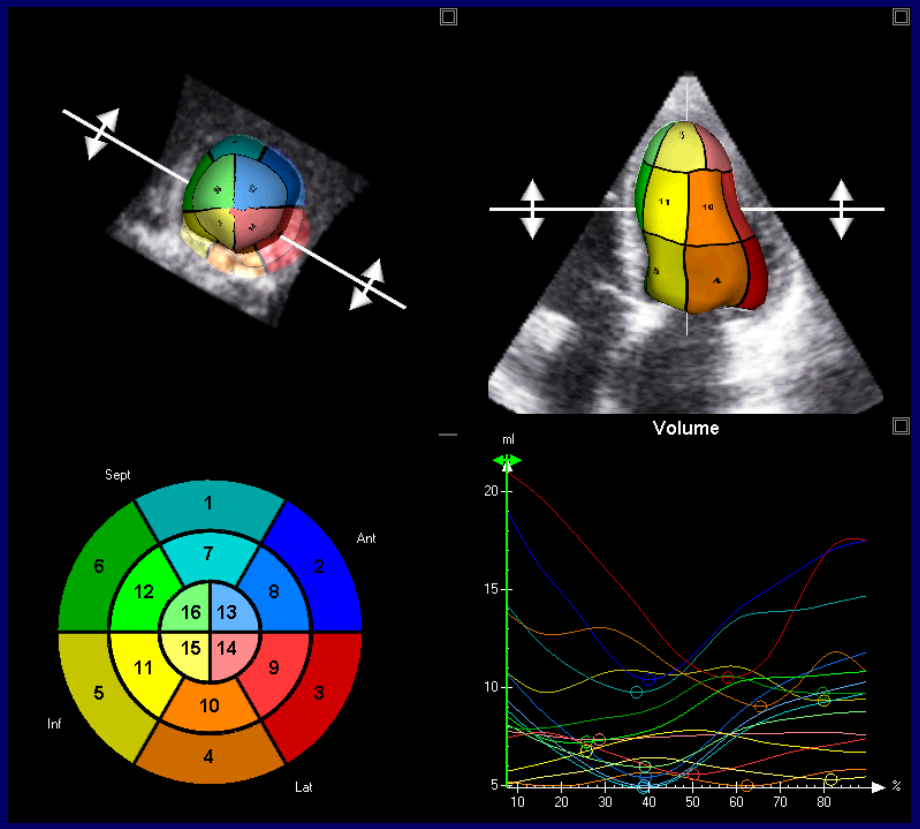
Electromechanical models of the ventricles

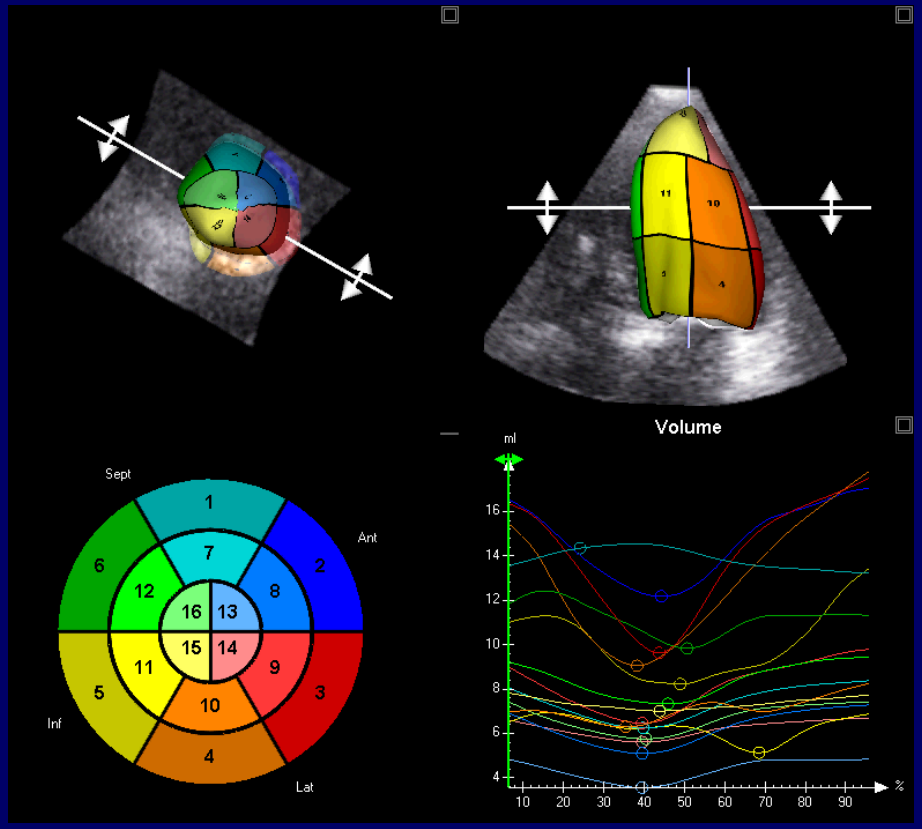


4D LV e ottimizzazione V-V

BASE

BIV





LVEF 23 %

LVEF 25 %

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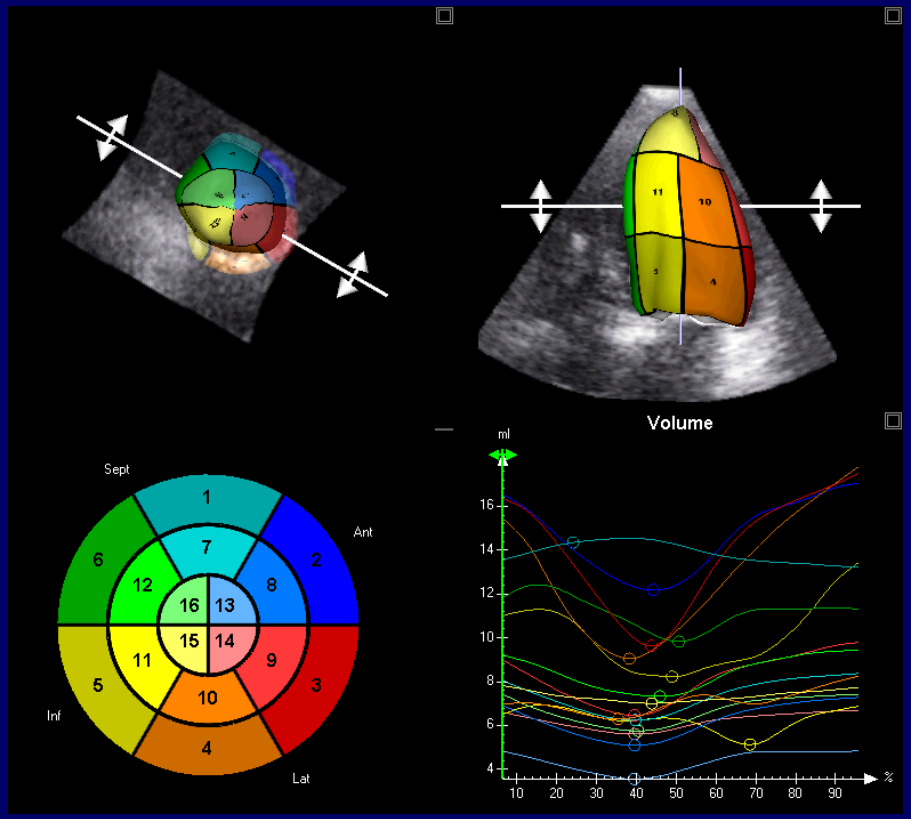
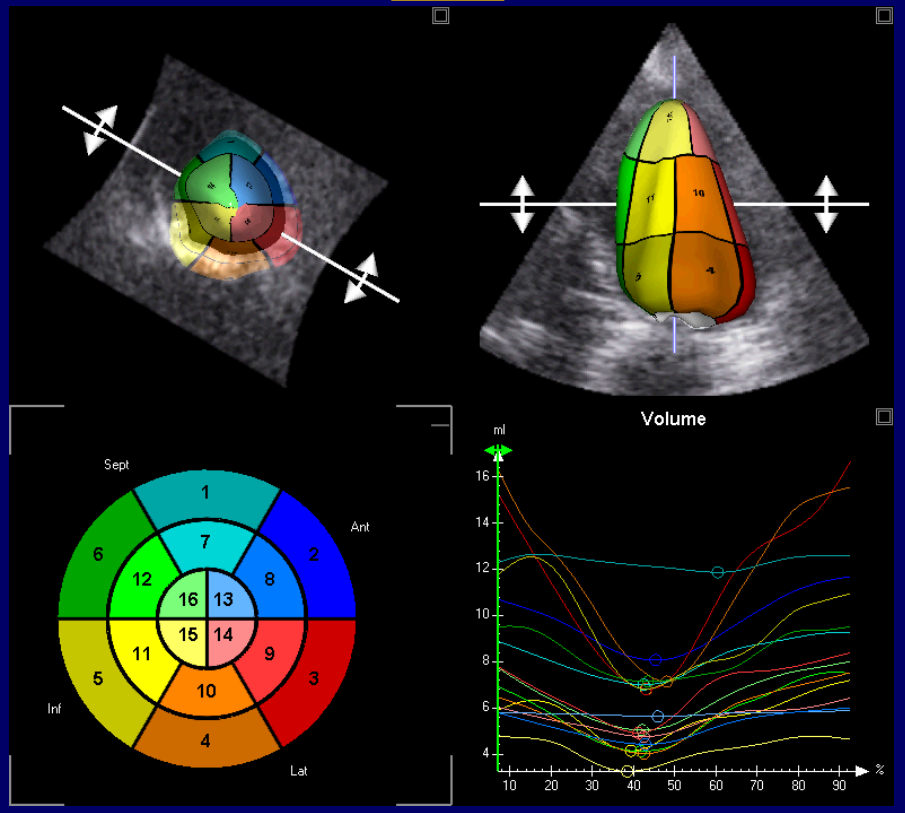
4D LV e ottimizzazione V-V

BIV V-V = 0



EDV	167 ml
ESV	124 ml
EF	25 %

LV



EDV	148 ml
ESV	96 ml
EF	35 %

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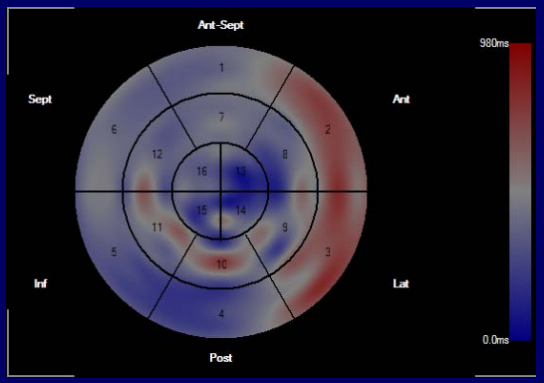
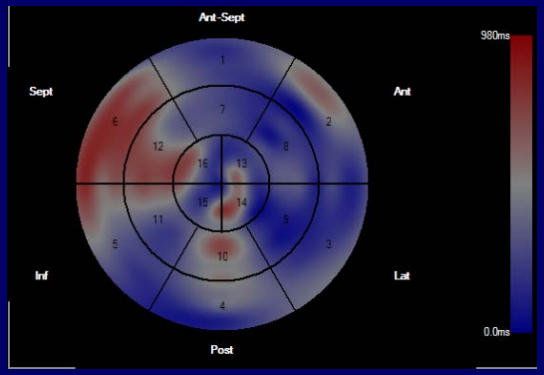
Programmazione Pacemaker con 4 D LV

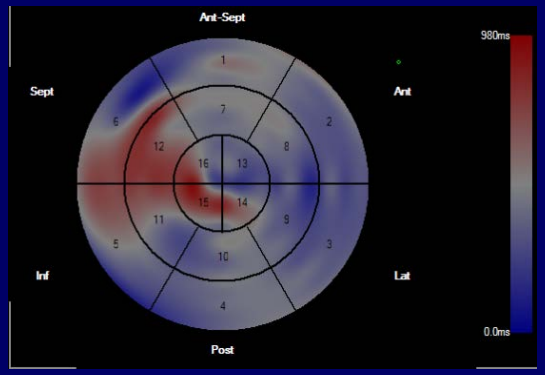
SR

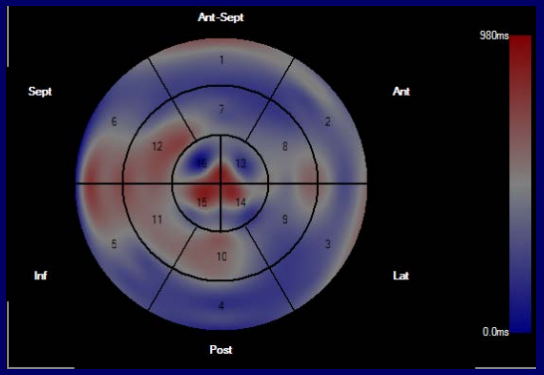


RV20

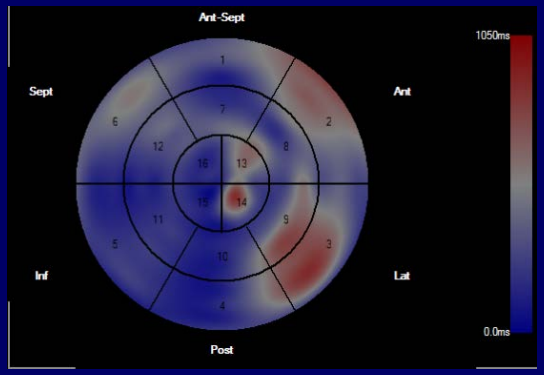


RV40

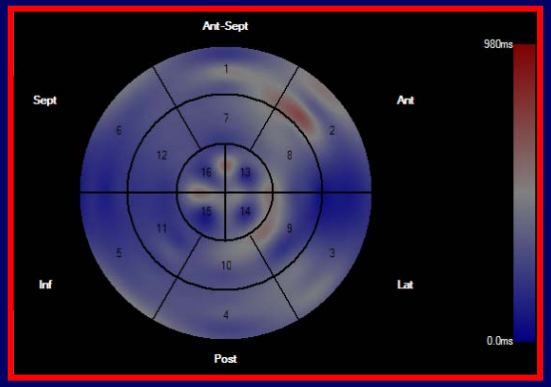




VV0



LV20



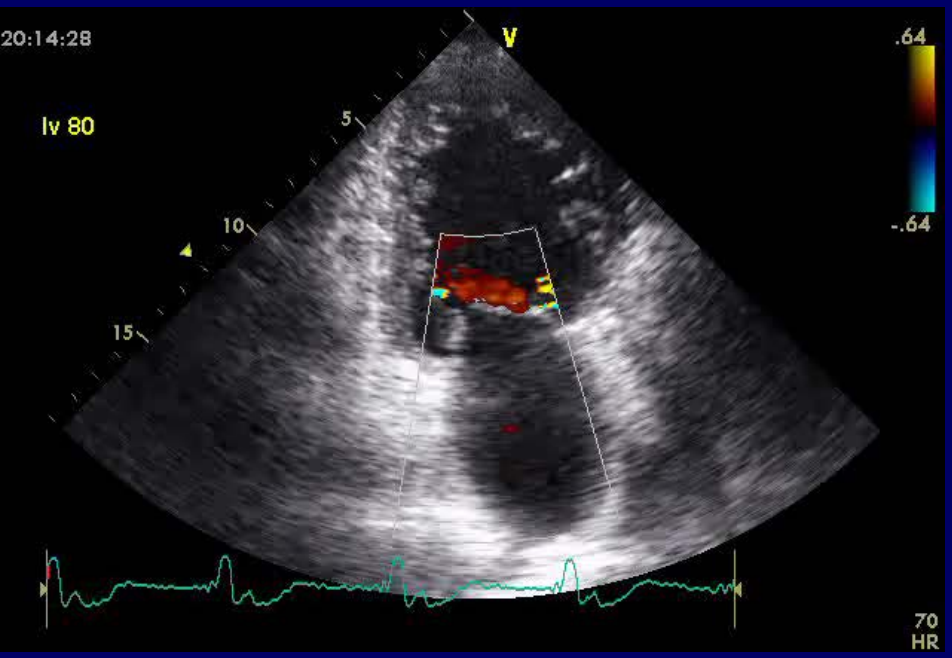
LV40

Visualization of contraction delays due to different pacemaker settings

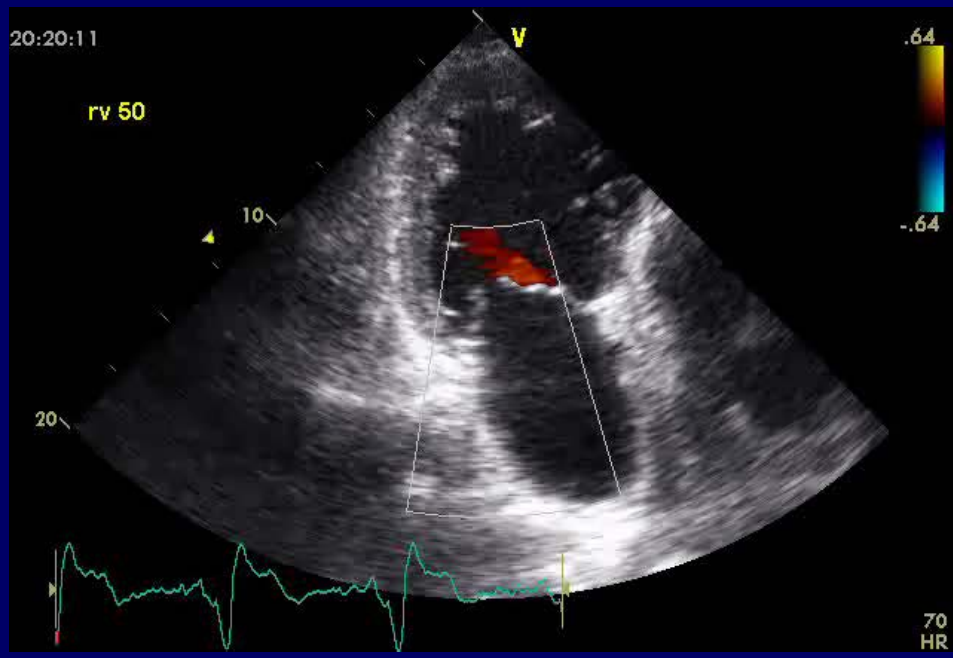
LV40 delivered best result

Three dimensional ventricular dyssynchrony: a fast and reliable parameter to optimize sequential biventricular pacing
Dr. Stéphane Lafitte et al. Hôpital Cardiologique Pessac, NASPE 2004

Riduzione dell'insufficienza mitralica con ottimizzazione del VV



- 80 ms (LV pre-excitation)



+ 50 msec (RV pre-excitation)

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Quali raccomandazioni dalle Linee guida ?

- performing AV interval optimization (echo guided or using invasive hemodynamic measurements)
- performing V-V optimization
- setting upper tracking limit (higher than the fastest sinus rate)
- setting automatic mode switch
- setting protection against endless-loop tachycardias
- setting rate-responsiveness in case of chronotropic incompetence
- setting diagnostic functions dedicated to detection of ventricular and atrial arrhythmias

EUROPACE, ESC Guidelines August 28th 2007

How to optimize AV interval

Table I Atrioventricular interval optimization methods

Echocardiography		Non-echocardiography
Optimization of LV diastolic filling	**Optimization of LV systolic function**	
• Iterative method • Ritter's method • Mitral inflow VTI • Meluzin's method	• LV dP/dt_{max} • LV outflow tract VTI • Myocardial performance index	• Invasive dP/dt_{max} • Impedance cardiography • Acoustic cardiography • Intracardiac electrograms

LV, left ventricular; VTI, velocity time integral.

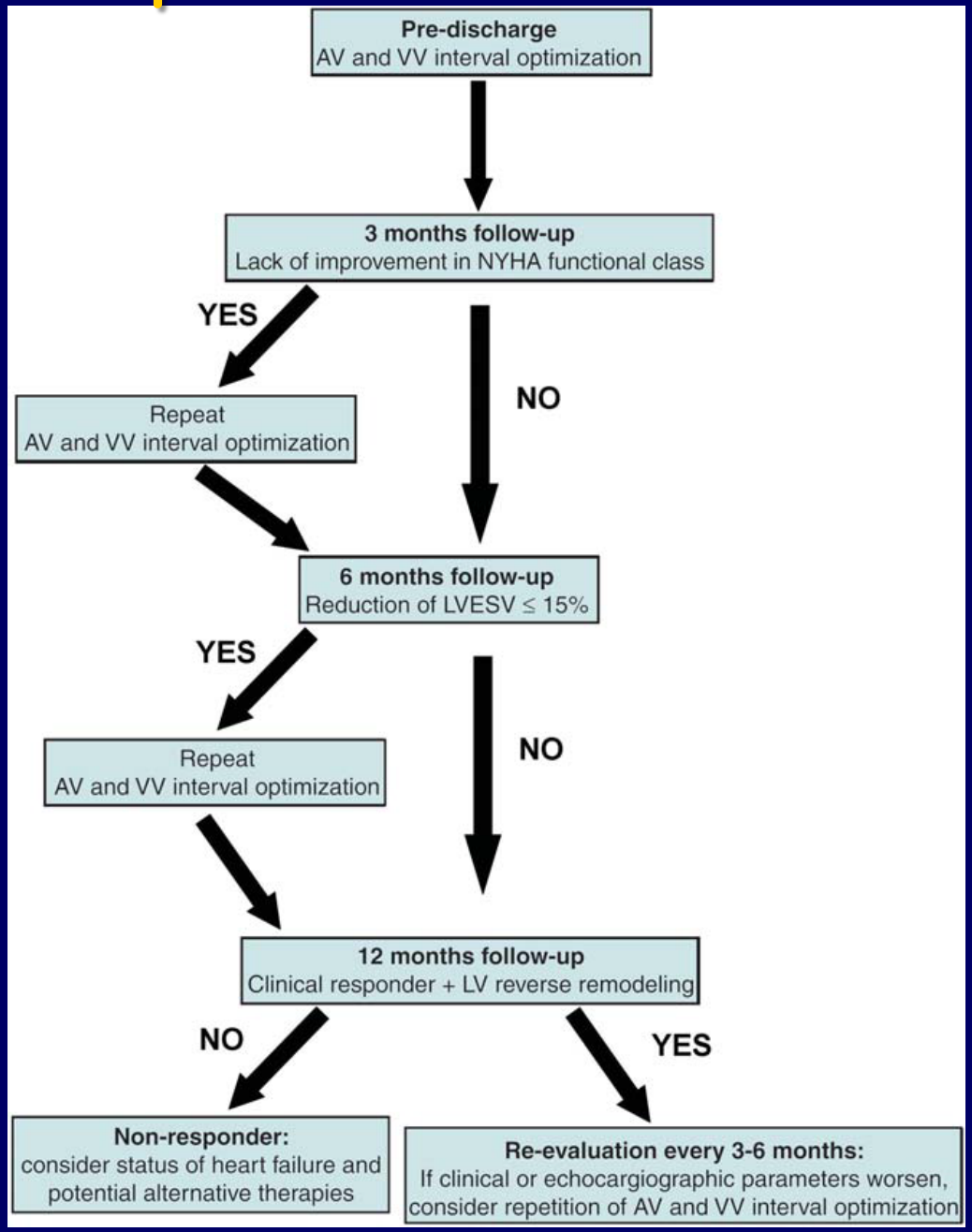
How to optimize VV interval

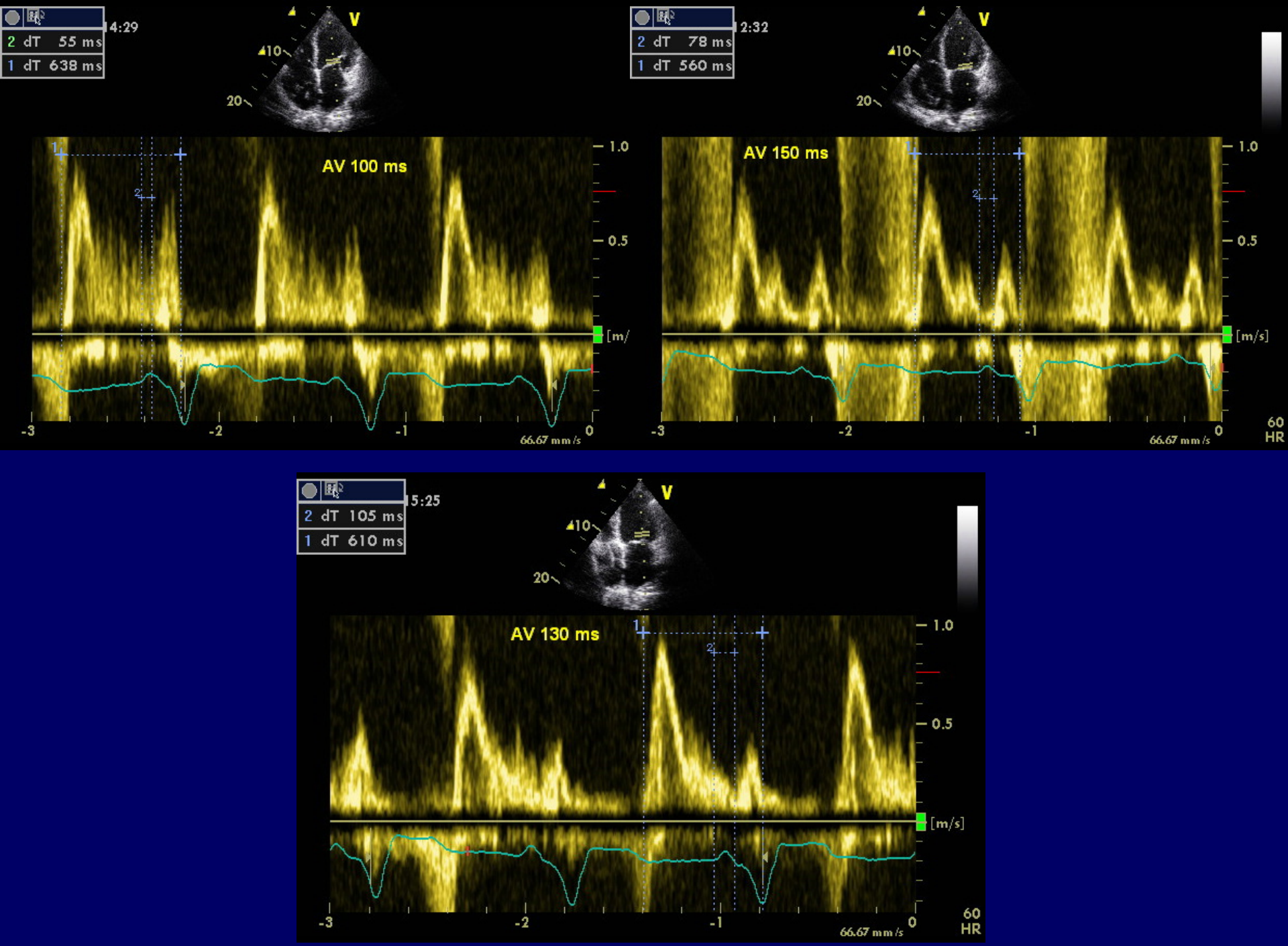
Table 2 Interventricular interval optimization methods

Echocardiography		Non-echocardiography
Optimization of LV systolic function	**Optimization of LV mechanical dyssynchrony**	
• LV outflow tract VTI	• Interventricular dyssynchrony (difference between aortic and pulmonary pre-ejection times) • Time to peak systolic velocity at TDI (time difference between two or four opposing walls, standard deviation of 12 LV segments) • Speckle-tracking echocardiography (radial, longitudinal and circumferential dyssynchrony) • Real time 3D echocardiography (systolic dyssynchrony index)	• Invasive dP/dt_{max} • Radionuclide ventriculography • Finger photo-plethysmography • Surface ECG • Impedance cardiography • Acoustic cardiography • Intracardiac electrograms

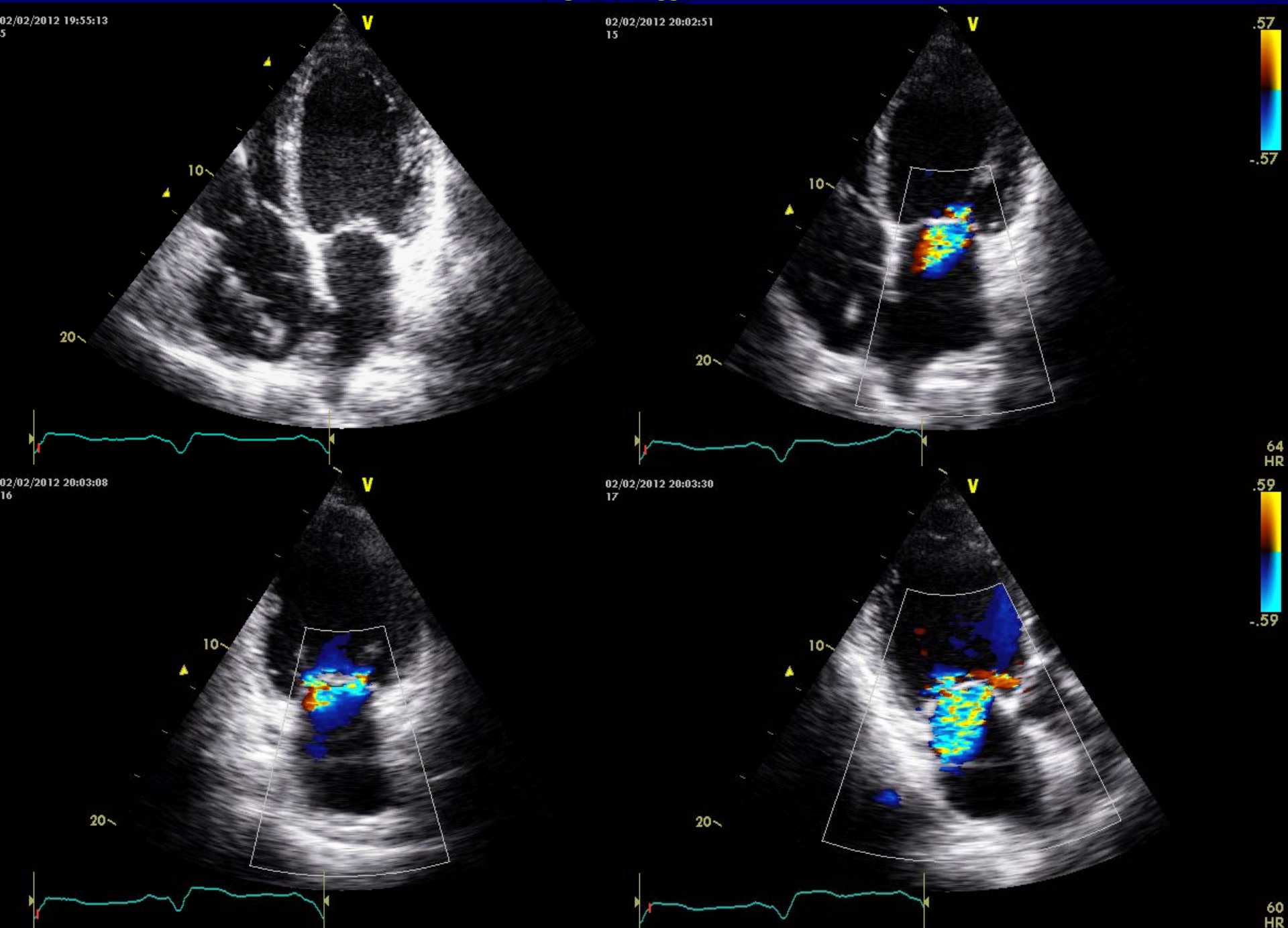
LV, left ventricular; TDI, tissue Doppler imaging; VTI, velocity time integral.

when to optimize AV and VV interval



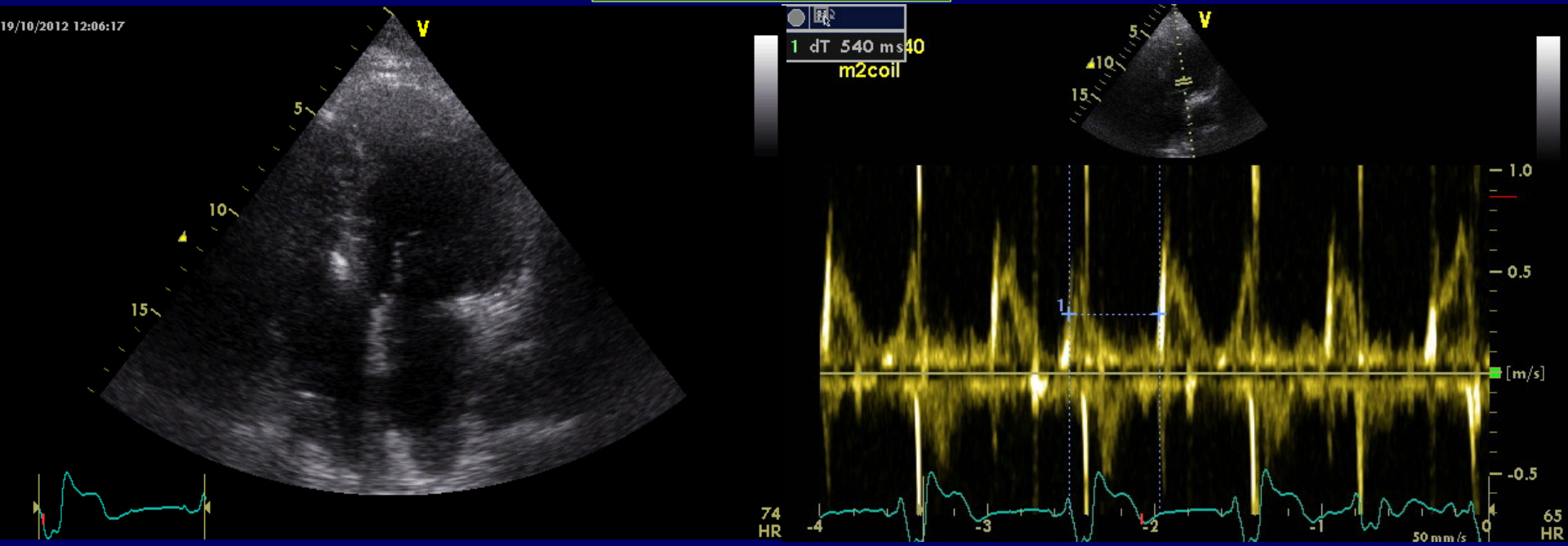

4:29
2 dT 55 ms
1 dT 638 ms
V
10
20
AV 100 ms
1.0
0.5
[m/
-3
-2
-1
0
66.67 mm/s
2:32
2 dT 78 ms
1 dT 560 ms
AV 150 ms
[m/s]
60
HR
5:25
2 dT 105 ms
1 dT 610 ms
AV 130 ms

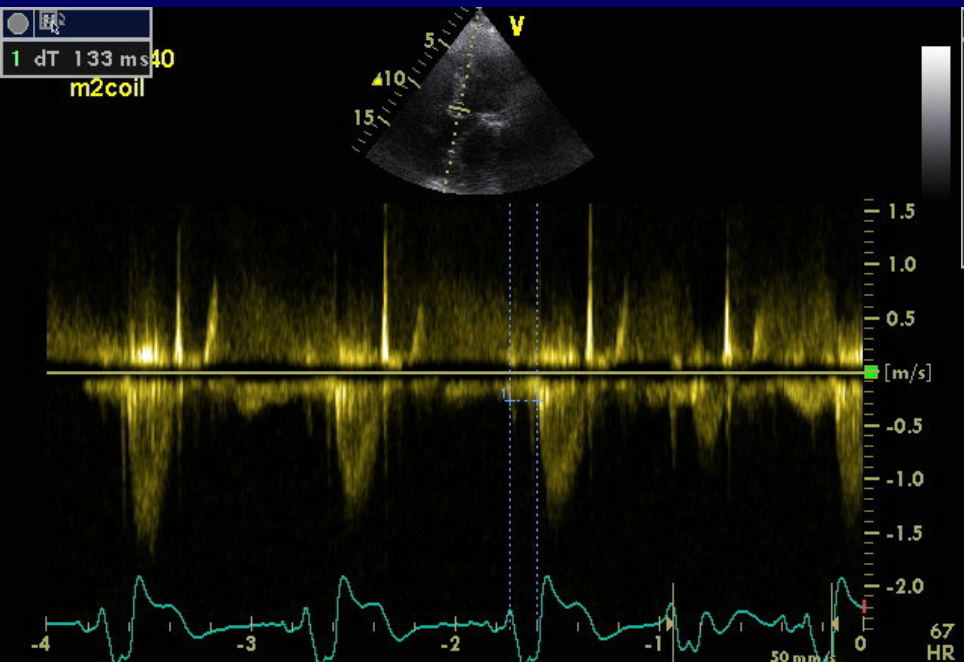
FU 24 mesi

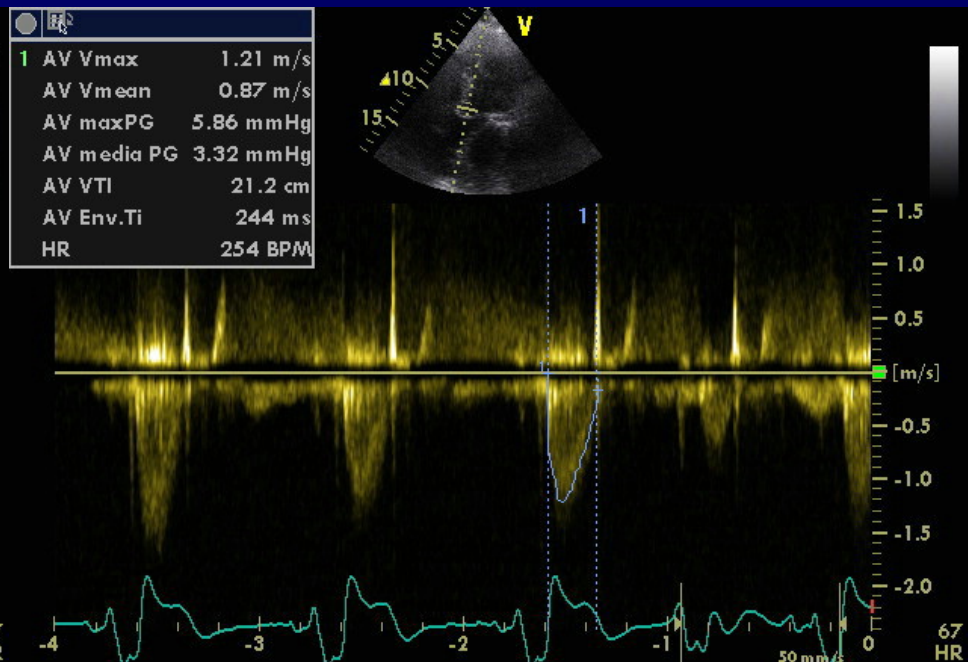

02/02/2012 19:55:13
5
02/02/2012 20:02:51
15
.57
-.57
64
HR
02/02/2012 20:03:08
16
02/02/2012 20:03:30
17
.59
-.59
60
HR

- G. G. 71 anni CMD idiopatica
- Ricovero per scompenso
- Ottimizzazione della terapia medica

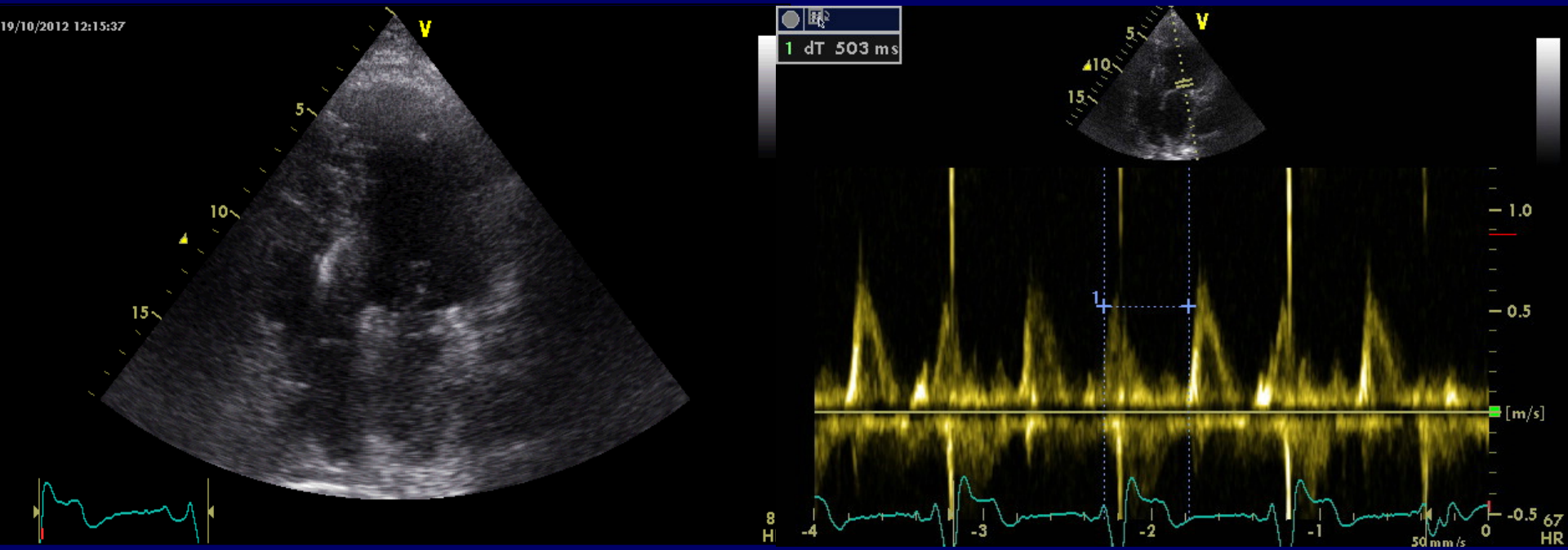
M2-Coil VV = - 40

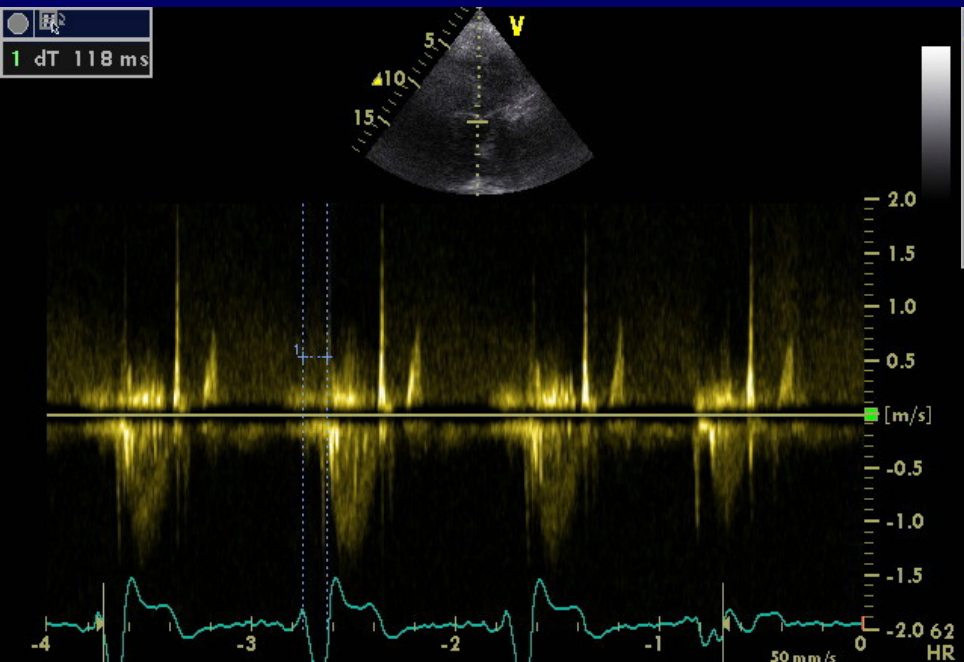

19/10/2012 12:06:17
1 dT 540 ms
m2coil
[m/s]
50 mm/s
74 HR
65 HR

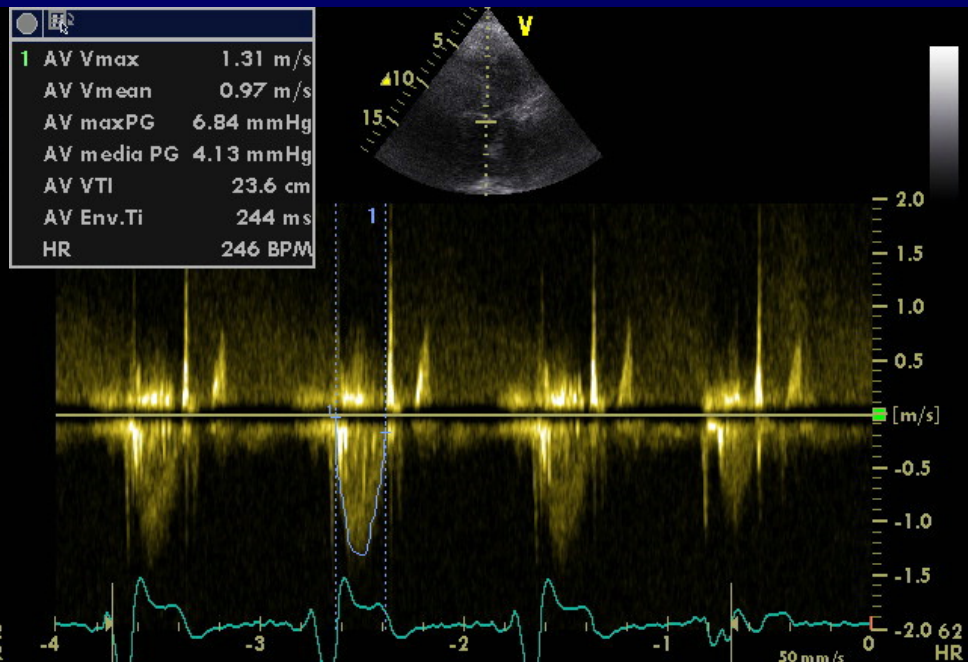

1 dT 133 ms
m2coil
[m/s]
50 mm/s
67 HR


1 AV Vmax 1.21 m/s
AV Vmean 0.87 m/s
AV maxPG 5.86 mmHg
AV media PG 3.32 mmHg
AV VTI 21.2 cm
AV Env.Ti 244 ms
HR 254 BPM
[m/s]
50 mm/s
67 HR

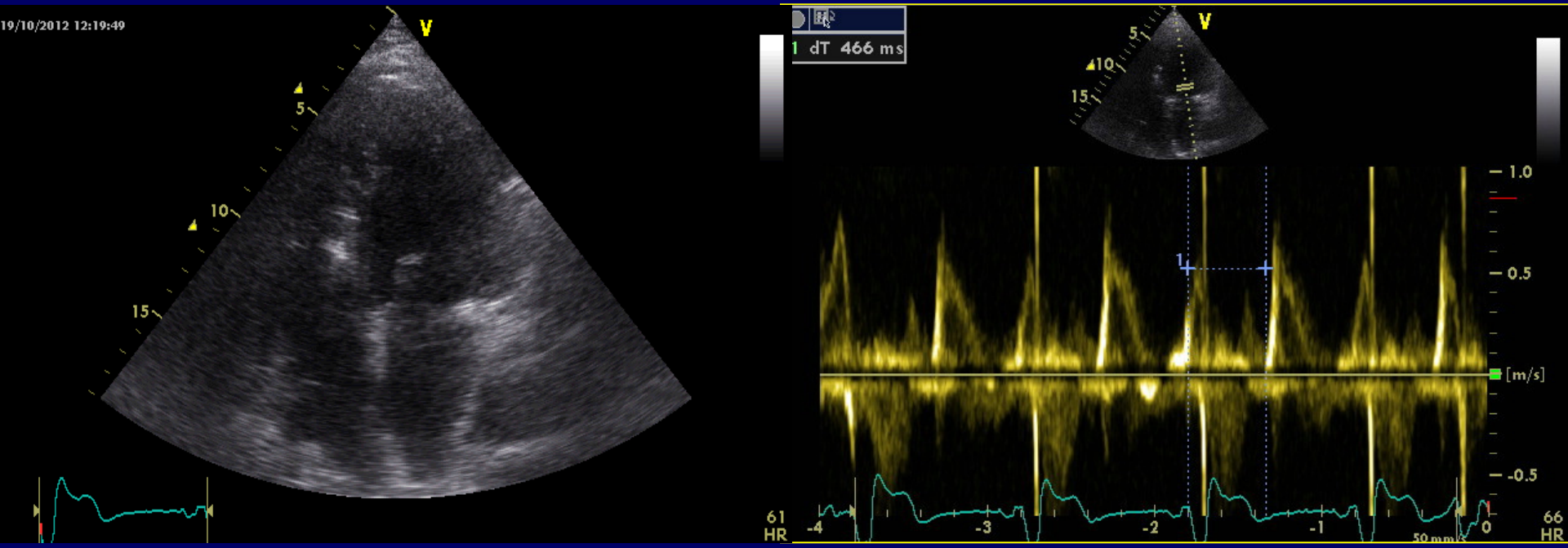
M2-Coil VV = 0

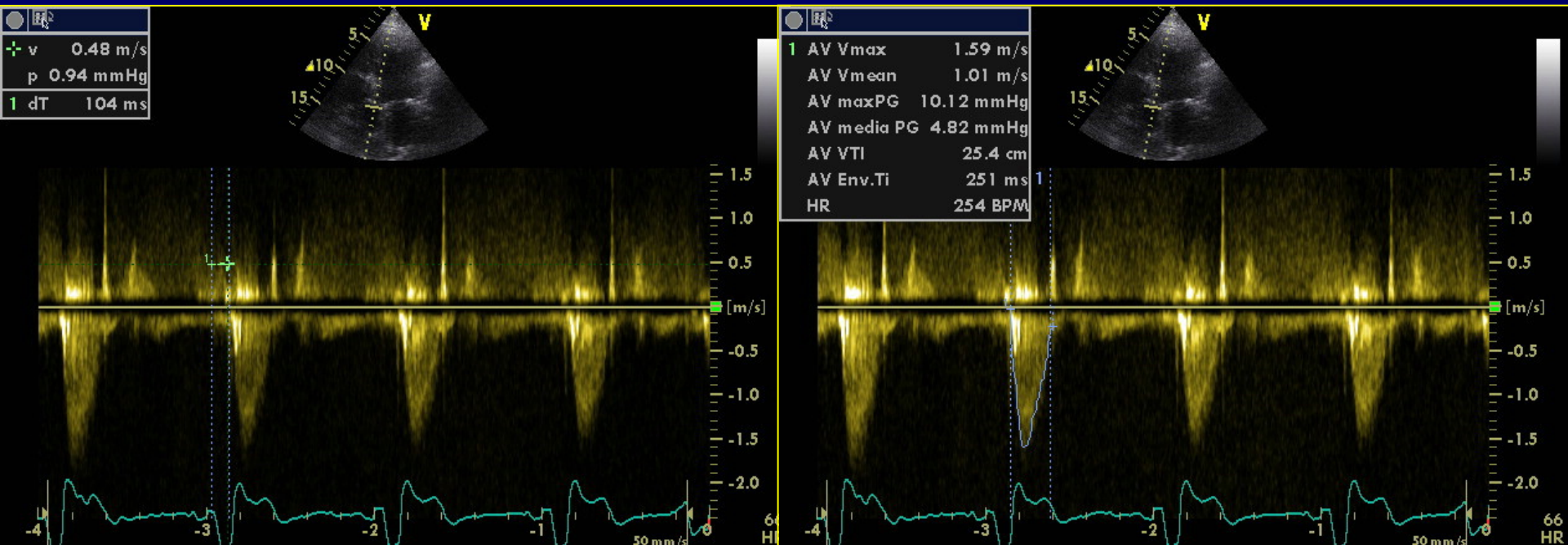

19/10/2012 12:15:37
1 dT 503 ms
[m/s]
50 mm/s
HR


1 dT 118 ms
[m/s]
50 mm/s
HR


1 AV Vmax 1.31 m/s
AV Vmean 0.97 m/s
AV maxPG 6.84 mmHg
AV media PG 4.13 mmHg
AV VTI 23.6 cm
AV Env.Ti 244 ms
HR 246 BPM
[m/s]
50 mm/s
HR

M2-M3 VV = 0


19/10/2012 12:19:49
V
5
10
15
1 dT 466 ms
1.0
0.5
[m/s]
-0.5
61
HR
-4
-3
-2
-1
0
66
HR


v 0.48 m/s
p 0.94 mmHg
1 dT 104 ms
1 AV Vmax 1.59 m/s
AV Vmean 1.01 m/s
AV maxPG 10.12 mmHg
AV media PG 4.82 mmHg
AV VTI 25.4 cm
AV Env.Ti 251 ms
HR 254 BPM
1.5
1.0
0.5
[m/s]
-0.5
-1.0
-1.5
-2.0
-4
-3
-2
-1
0
50 mm/s

Conclusions

- Short AV delay and optimal V-V delay favourably affect LV performance by improving LV filling time
- While AV delay can easily be settled, V-V delay has to be chosen on the basis of different parameters
- 4D LV LVEF probably is the most powerful method to identify the best results delivering V-V delay